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Congressional Committees

Missile Defense: Assessment of DOD's Reports on Status of Efforts and Options for Improving Homeland Missile Defense

The Missile Defense Agency (MDA) is developing the Ballistic Missile Defense System (BMDS) to defend the U.S. homeland and U.S. regional friends and allies against ballistic missile attacks from countries such as North Korea and Iran. To counter such threats to the U.S. homeland, the BMDS is designed to combine the capabilities of the Ground-based Midcourse Defense (GMD) system with a network of ground-, sea-, and space-based sensors to provide an integrated, layered defense. GMD defends against threats by launching ground-based interceptors that release kill vehicles to find and destroy the threat.

According to the Department of Defense (DOD), protection of the United States from the threat of ballistic missile attacks is a critical national security priority. In building that protection, MDA has spent tens of billions of dollars developing the GMD system, including: fielding ground station assets and a fleet of over 30 GMD interceptors; upgrading, redesigning, refurbishing, and retrofitting the system; and performing eight intercept flight tests, four of which were successful.¹ According to DOD's Office of the Director, Operational Test and Evaluation, GMD has demonstrated a partial capability to defend the U.S. homeland against a simple ballistic missile attack from North Korea or Iran. According to MDA, the current GMD kill vehicle design and concept of operations represent a performance plateau that cannot be overcome without augmenting and replacing the kill vehicles in the current fleet of fielded interceptors. Doing so would likely require a multibillion dollar investment by MDA. To that end, DOD is conducting a formal study to assess options, called an analysis of alternatives (AOA), to identify potential cost-effective solutions for improving homeland ballistic missile defense.

The National Defense Authorization Act for Fiscal Year 2014 (FY14 NDAA) and the National Defense Authorization Act for Fiscal Year 2015 (FY15 NDAA) required DOD to assess options for improving homeland ballistic missile defense. More specifically, section 238 of the FY14 NDAA required the Secretary of Defense to submit to congressional defense committees a report that included, among other items, an evaluation of the advantages and disadvantages of potential future options for improving homeland ballistic missile defense, including consideration of each option's technical feasibility, operational effectiveness, cost effectiveness, schedule, and agility to respond to future changes in the threat. Section 1665(b) of the FY15 NDAA required the Director of MDA to submit to the congressional defense committees a report that included, among other items, an evaluation of the benefits and drawbacks of potential options to improve homeland ballistic missile defense capability against a potential, emerging Iranian ballistic missile threat. DOD submitted a report entitled *Potential Future Homeland Ballistic Missile*

¹Three of the test failures were due to kill vehicle failures. One of the test failures was due to a target failure. For more information, see GAO, *Missile Defense: Opportunities Exist to Reduce Acquisition Risk and Improve Reporting on System Capabilities*, GAO-15-345 (Washington, D.C.: May 6, 2015), 62.

Defense Options on August 13, 2015, to satisfy the FY14 NDAA requirement and another report entitled *Status of Current and Planned Efforts to Improve Homeland Ballistic Missile Defense* on September 17, 2015, to satisfy the FY15 NDAA requirement.

The joint explanatory statements for both the FY14 NDAA and FY15 NDAA included provisions for GAO to brief the congressional defense committees on our views of DOD's reports on homeland ballistic missile defense. The joint explanatory statement for the FY15 NDAA also included a provision for GAO to submit a report on our views of DOD's report as soon as practicable. We assessed (1) the extent to which DOD's reports addressed the required reporting elements from the FY14 NDAA and FY15 NDAA and (2) the benefits and risks associated with the plans and efforts described in the DOD's reports. This report documents the findings we presented during our briefings with the congressional defense committees in October 2015 and meets the reporting requirement.

To assess the extent to which DOD's reports addressed the required reporting elements, we identified reporting elements from section 238 of the FY14 NDAA and section 1665 of the FY15 NDAA. We reviewed DOD's reports and assessed the extent to which statements addressed each report's required reporting elements. To identify the benefits and risks associated with the plans and efforts described in DOD's reports, we compared information in those reports to GAO's best practices for following a knowledge-based acquisition approach and improving competition, as described in our prior reports on missile defense and other major defense acquisition programs.² We also reviewed information from MDA program management documents and met with officials from MDA, U.S. Northern Command, and U.S. Strategic Command to corroborate key acquisition information.

We conducted this performance audit from August 2015 to February 2016 in accordance with generally accepted government auditing standards. Those standards require that we plan and perform the audit to obtain sufficient, appropriate evidence to provide a reasonable basis for our findings and conclusions based on our audit objectives. We believe that the evidence obtained provides a reasonable basis for our findings and conclusions based on our audit objectives.

Summary

DOD's reports on homeland missile defense addressed most of the required reporting elements from the FY14 NDAA and FY15 NDAA. However, the reports generally did not meet the requirements for evaluating options for improving homeland missile defense and were not submitted by the required deadlines. Rather than including in its reports the required evaluation of options, DOD referred the congressional defense committees to a separate, ongoing study being performed by the department to assess future homeland missile defense options and committed to providing them with results when the study is completed.

Although DOD's reports described the benefits of MDA's ongoing efforts to improve homeland missile defense, we found that MDA faces risks and challenges pursuing these efforts. For

²For examples, see GAO, *Best Practices: Better Matching of Needs and Resources Will Lead to Better Weapon System Outcomes*, GAO-01-288 (Washington, D.C.: Mar. 8, 2001); *Defense Acquisitions: A Knowledge-Based Funding Approach Could Improve Major Weapon System Program Outcomes*, GAO-08-619 (Washington, D.C.: July 2, 2008); *Best Practices: DOD Can Achieve Better Outcomes by Standardizing the Way Manufacturing Risks Are Managed*, GAO-10-439 (Washington, D.C.: Apr. 22, 2010); and *Missile Defense: Opportunities Exist to Strengthen Acquisitions by Reducing Concurrency*, GAO-12-486 (Washington, D.C.: Apr. 20, 2012).

example, DOD's reports stated that the U.S. homeland is currently protected from a limited ballistic missile attack from North Korea and Iran. MDA has demonstrated some of this capability but several other key aspects necessary to prove it can defend the U.S. homeland against the current ballistic missile threat have not been demonstrated. DOD's reports also described ongoing efforts to meet a directive from the Secretary of Defense to field 44 GMD interceptors by the end of 2017. However, we found that, although MDA has made progress towards achieving the fielding goal, MDA is relying on a highly optimistic, aggressive schedule that overlaps development and testing with production activities, compromises reliability, extends risk to the warfighter, and risks the efficacy of flight testing. In addition, DOD's report described the potential benefits of MDA's approach for acquiring the Redesigned Kill Vehicle (RKV), including aligning production decisions with flight testing and including margin in its development schedule. However, MDA may encounter challenges with the RKV's contract strategy, industry collaboration efforts, and schedule because MDA has not yet negotiated the terms of the RKV modification with the prime contractor, is relying on potential industry competitors to collaborate on developing the RKV, and may need additional time to develop some components for their use in the RKV.

In our prior work on missile defense, we made several recommendations aimed at assisting MDA in improving its acquisition outcomes and minimizing risk, such as implementing a knowledge-based acquisition strategy, including sufficient schedule and resource margin in its test plan, and aligning production decisions with flight testing. MDA concurred with many of our recommendations and has taken some actions to address them but several of our recommendations have not been implemented. We continue to believe these recommendations are valid and should be fully implemented.

Background

We found in April 2014 that a series of GMD test failures in conjunction with a highly concurrent development, production, and fielding strategy caused major disruptions to the program.³ MDA has relied on high levels of concurrency as part of its efforts to quickly field GMD capabilities in order to meet presidentially-directed deadlines. We have found that successful programs require an appropriate balance between schedule and risk that does not include an undue amount acquisition concurrency, where overlap occurs between technology development and product development or between product development and production of a system.⁴ While some concurrency is understandable, committing to product development before requirements are understood and technologies are mature, as well as committing to production and fielding before development is complete is a high-risk strategy that often results in performance shortfalls, unexpected cost increases, schedule delays, and test problems.

MDA has efforts ongoing to address concerns with the current generation GMD kill vehicle, called the Capability Enhancement-II (CE-II), and increase protection to the U.S. homeland. In March 2013, the Secretary of Defense directed MDA to increase the number of fielded GMD interceptors from 30 to 44 by the end of 2017. To achieve this fielding goal, MDA has performed a limited redesign of the CE-II, called the CE-II Block I, to fix known issues, address

³GAO, *Missile Defense: DOD's Report Provides Limited Insight on Testing Options for the Ground-based Midcourse Defense System*, GAO-14-350R (Washington, D.C.: Apr. 30, 2014) and *Missile Defense: Mixed Progress in Achieving Acquisition Goals and Improving Accountability*, GAO-14-351 (Washington, D.C.: Apr. 1, 2014).

⁴GAO-15-345.

obsolescence, and improve producibility and cost. MDA also performed an extensive upgrade to the boost vehicle to improve reliability and address obsolescence issues. MDA plans to produce 11 new CE-II Block I interceptors with deliveries beginning in fiscal year 2017. DOD, in its September 2015 report, stated that MDA will execute an intercept flight test with the full CE-II Block I configuration before starting CE-II Block I deliveries.

Although the CE-II Block I will address some concerns with the CE-II design, MDA determined a more complete redesign of the CE-II was needed. Section 225 of the National Defense Authorization Act for Fiscal Year 2013 required MDA to develop a long-term plan for the EKV, including options for the competitive development of a next generation EKV. MDA received requirements for the redesign effort—an effort MDA calls the Redesigned Kill Vehicle (RKV)—from the U.S. Strategic Command and developed an RKV acquisition strategy that was approved by the Under Secretary of Defense for Acquisition, Technology, and Logistics (USD AT&L). MDA initially considered conducting a full and open competition and, according to GMD's fiscal year 2016 budget request, planned to award a contract for the RKV development. However, MDA adjusted its plans to perform the RKV development under the GMD Development and Sustainment Contract (DSC) which was competitively awarded to Boeing in December 2011. Although MDA notes that the DSC was not structured or competed to include the RKV effort, the agency plans to add the new RKV scope to the DSC under an exception to federal acquisition laws that authorizes, under certain conditions, contracting without full and open competition.⁵ MDA justified this approach based on a determination that only one responsible source—Boeing—will satisfy the requirements to begin delivering RKVs in 2020 to defeat the estimated emerging threat and that awarding the RKV development effort to any other source would result in unacceptable delays in fulfilling these requirements. To that end, MDA will have to negotiate a modification to the DSC with Boeing.

According to MDA, the RKV will be designed to be more reliable, producible, testable, and cost-effective, in part, by incorporating a modular open architecture concept with common interfaces and standards for its subsystems, called modules. Under the DSC, MDA plans to form a cross industry team consisting of Boeing, Raytheon, and Lockheed Martin, which will develop the RKV. Raytheon is to be the RKV integrator and Boeing is to continue as the prime contractor under the DSC and GMD interceptor integrator. MDA plans to initially produce eight RKVs with the development team under the DSC to prove out the design and production readiness. At the direction of the USD AT&L and with the Director, MDA's concurrence, the agency plans to conduct a full and open competition for the RKV full rate production contract to produce an additional 37 RKVs.

⁵10 U.S.C. § 2304(c); Federal Acquisition Regulation (FAR) § 6.302.

DOD's Reports Addressed Most of the Required Reporting Elements but Generally Did Not Meet the Requirements for Evaluating Options for Improving Homeland Missile Defense

DOD's reports generally met most of the required reporting elements from the FY14 NDAA and FY15 NDAA. Our analysis of DOD's reports is summarized in table 1 below.

Table 1: Assessment of DOD's Reports on Homeland Missile Defense and Reporting Requirements

Fiscal Year 2014 National Defense Authorization Act, Section 238 Reporting Requirements		Assessment
Description of current and future ballistic missile threat assessment.		Generally met
Description of current homeland ballistic missile defense (BMD) capability against current threat.		Generally met
Status of efforts to address prior Ground-based Midcourse Defense (GMD) test failures.		Generally met
Description of planned improvements to current homeland BMD.		Generally met
Evaluation of the advantages and disadvantages of options to improve homeland BMD.		Generally not met DOD's August 2015 report did not include an evaluation of both the advantages and disadvantages for each of the options it was required to assess.
Conclusions and recommendations.		Generally met
Fiscal Year 2015 National Defense Authorization Act, Section 1665 Reporting Requirements		Assessment
Description of current and future ballistic missile threat assessment.		Generally met
Status of efforts to address prior GMD test failures.		Generally met
Status of efforts fielding 14 additional GMD interceptors at Fort Greely, Alaska.		Generally met
Description of plans and progress to improve capability, reliability, and availability of fielded GMD interceptors.		Generally met
Description of planned improvements to homeland BMD sensors and discrimination capabilities.		Generally met
Description of plans and efforts to redesign GMD kill vehicle.		Generally met
Description of plans and capabilities for next generation kill vehicle.		Generally met
Status of efforts and goals for multiple object kill vehicle.		Generally met
Evaluation of the potential benefits and drawbacks of options to improve homeland BMD.		Generally not met DOD's September 2015 report did not include an evaluation of both the benefits and drawbacks for each of the options it was required to assess.
Any other matters the Director, Missile Defense Agency considers appropriate.		Generally met

Source: GAO analysis of DOD's August 2015 and September 2015 homeland BMD reports. | GAO-16-254R

Notes:

For a detailed description of the reporting requirements, see National Defense Authorization Act for Fiscal Year 2014, Pub. L. No. 113-66, § 238 (2013); and National Defense Authorization Act for Fiscal Year 2015, Pub. L. No. 113-291, § 1665(b) (2014).

Generally met: The majority of a reporting requirement's components were qualitatively addressed through statements identified in DOD's reports. Generally not met: Less than a majority of a reporting requirement's components were qualitatively addressed through statements identified in DOD's reports.

DOD's reports generally did not meet the requirements to include an evaluation of potential options for improving homeland ballistic missile defense. For example, the FY14 NDAA identified the Aegis Ballistic Missile Defense Standard Missile-3 Block IIA interceptor as an option DOD was to assess for improving homeland ballistic missile defense. In its August 2015 report, DOD described MDA's current plans for deploying the Block IIA interceptor in Romania,

Poland, and at sea in 2018 for the defense of Europe, not the United States. Rather than performing the required evaluation of options, DOD referred the congressional defense committees to the ongoing AOA for homeland ballistic missile defense and committed to providing them with the AOA when completed.

Both the FY14 NDAA and FY15 NDAA established deadlines for DOD to submit its reports; however, DOD was approximately one year late in submitting its August 2015 report and three months late in submitting its September 2015 report. DOD's report submitted in response to section 238 of the FY14 NDAA was effectively due August 23, 2014, but DOD did not submit the report until August 13, 2015. In addition, DOD's report submitted in response to section 1665 of the FY15 NDAA was effectively due June 17, 2015, but DOD did not submit the report until September 17, 2015. Some of the delays were driven by DOD's process for coordinating review of the draft reports. For example, according to MDA, it took DOD approximately 13 months to provide the report to department stakeholders, adjudicate comments, incorporate changes to the report, and receive approval from the USD AT&L to release the report.

DOD's Reports Described Progress but MDA Has Not Proven GMD Can Defend the Homeland and May Experience Challenges Improving the System

DOD's reports described significant progress in fielding new assets to improve current homeland defense capabilities, such as fielding eight new CE-II interceptors, deploying an in-flight interceptor communications terminal in Fort Drum, New York, and fielding a forward-based transportable radar in Kyogamisaki, Japan. In addition, according to MDA, it performed a non-intercept test in January 2016 that demonstrated technology to discriminate countermeasures carried by the target and successfully evaluated the performance of the CE-II kill vehicle's redesigned thrusters intended to minimize rough combustion—a problem which program officials said has challenged the aerospace industry for decades. However, MDA has not demonstrated several key homeland missile defense capabilities and is relying on high-risk acquisition practices to achieve its goal of fielding 44 interceptors by the end of 2017. In addition, DOD's reports described the potential benefits of MDA's RKV acquisition approach but the agency may encounter some challenges with its execution.

MDA Has Not Demonstrated Through Flight Testing That It Can Defend the U.S. Homeland Against the Current Missile Defense Threat

DOD's August 2015 report stated that the BMDS is capable of defending the U.S. homeland against the threat of a limited intercontinental ballistic missile attack from countries such as North Korea and Iran. According to recent testimony from senior DOD officials, the warfighter remains confident in its ability to protect the nation from a limited intercontinental ballistic missile attack.⁶ However, several key aspects of this capability have not been demonstrated through flight testing. In May 2015, we reported that MDA previously conducted three successful CE-I intercept flight tests and achieved a major milestone when it performed its first successful intercept test with the CE-II, the first of several needed successful intercept tests to fully demonstrate the CE-II works as intended.⁷ Some of the capabilities that both MDA and the

⁶*Fiscal Year 2016 National Defense Authorization Budget Request for Missile Defense Programs, Before the S. Comm. on Strategic Forces*, 114th Cong. (Mar. 19, 2015).

⁷See GAO-15-345.

warfighter have identified that need to be demonstrated include intercepting a target representative of an intercontinental ballistic missile and performing a salvo intercept where two or more interceptors are utilized against a single target. The salvo capability is particularly important because, during a ballistic missile attack, the warfighter intends to launch a salvo of interceptors to increase the probability of successfully intercepting the incoming missiles and to overcome anticipated in-flight reliability failures.

According to a March 2015 assessment by DOD's Office of the Director, Operational Test and Evaluation (DOT&E), GMD has demonstrated a partial capability against small numbers of simple ballistic missile threats launched from North Korea and Iran; GMD flight testing, to date, was insufficient to demonstrate that an operationally useful defense capability exists; and a quantitative assessment of GMD's operational effectiveness is currently not possible. DOT&E stated in a January 2016 report that its assessment of GMD remained unchanged. In February 2010, we recommended that MDA should ensure that development changes to operational assets do not disrupt assessments needed to allow the warfighter and testers to fully understand and verify fielded BMDS capabilities.⁸ DOD concurred with our recommendation but stated that it remained committed to fielding new assets while performing testing and assessment activities in parallel despite the lower level of confidence associated with this approach. We continue to believe that our recommendation has merit and should be fully implemented because fielding unproven assets extends risk to the warfighter and forces them to operate a system for which they may not have a full understanding of its capabilities and limitations.

MDA Is Relying on High-Risk Acquisition Approach to Achieve Fielding Goals

DOD's reports described MDA's ongoing efforts to improve homeland missile defense and increase the number of fielded GMD interceptors, as directed by the Secretary of Defense, from 30 to 44 by the end of 2017. To that end, MDA has achieved progress in reaching this goal by fielding new CE-II interceptors and continuing to successfully conduct flight tests. In addition, MDA has begun implementing a reliability improvement program to reduce the program's technical risks. However, MDA's approach to achieve its fielding goal relies on high-risk acquisition practices similar to those employed to develop, produce, and field the CE-II, which, as we previously described above, resulted in major disruptions to the program. To achieve its current fielding goal, MDA is relying on a highly optimistic, aggressive schedule which has resulted in MDA: (1) accepting a proven risk of undue concurrency; (2) compromising interceptor reliability and extending risk to the warfighter; and (3) risking the efficacy of its planned flight tests in order to maintain schedule-driven deadlines necessary to meet its 2017 fielding deadline. For example:

1. **CE-II Block I concurrency:** In July 2014, we found that the GMD program planned to begin CE-II Block I production prior to conducting an intercept flight test to demonstrate the new interceptor design works as intended.⁹ This approach runs counter to best practices for DOD's weapon system acquisition process, which state that the demonstration flight test should be conducted before starting production of assets for

⁸GAO, *Defense Acquisitions: Missile Defense Transition Provides Opportunity to Strengthen Acquisition Approach*, GAO-10-311 (Washington, D.C.: Feb. 25, 2010).

⁹GAO, *Missile Defense: DOD's Report Provides Limited Insight on Improvements to Homeland Missile Defense and Acquisition Plans*, GAO-14-626R (Washington, D.C.: July 17, 2014).

operational use.¹⁰ As such, in May 2015, we recommended that MDA delay CE-II Block I production until MDA successfully conducted a demonstration flight test.¹¹ DOD stated that delaying interceptor production and integration until the flight test is conducted would unacceptably increase the risk to reaching the Secretary of Defense's mandate of achieving 44 emplaced interceptors by the end of 2017. We continue to believe the recommendation has merit and that MDA should delay assembling interceptors intended for fielding prior to conducting the flight test. In April 2012, we recommended that the USD AT&L review all MDA acquisitions for concurrency, and determine whether the proper balance has been struck between the planned deployment dates and the concurrency risks taken to achieve those dates.¹² DOD concurred with our recommendation and, in August 2013, the USD AT&L provided a report to the congressional defense committees that concluded GMD's established knowledge points and milestones were sufficient to mitigate the program's concurrency risks from materializing. However, a month prior to the report's issuance, GMD experienced its fourth failed intercept test. Because MDA produced the current fleet of interceptors before completing testing, the test failure exacerbated disruptions to the program and contributed to a six-and-a-half-year delay and an approximate \$1.75 billion cost increase to the GMD program.

2. **Alternate Divert Thrusters (ADT) reliability:** MDA's approach for overcoming delays developing new thrusters for the kill vehicles may allow the agency to meet its fielding goals but increases the risk for reliability issues going undetected before being delivered to the warfighter. MDA has previously experienced challenges and delays developing the ADT, a component intended to resolve performance issues with the kill vehicle's current divert thrusters. MDA recently conducted a non-intercept test in January 2016, which, according to MDA, allowed it to successfully evaluate the ADT's performance. However, because of prior development delays, MDA now plans to integrate the ADT on the kill vehicle later in the production process, after the first round of factory environmental testing has been performed on the kill vehicle. Although each ADT produced is to undergo some functional and environmental testing, MDA does not intend to "hot-fire" each ADT before integration—a test that verifies proper performance and workmanship. As a result, the first time the ADT will be fired is in flight. The reduced amount of ADT testing during production increases the risk of workmanship errors going undetected and failures being discovered during flight. We found in April 2012 that MDA previously experienced a GMD flight test failure because of a quality control escape during the kill vehicle manufacturing process.¹³ To that end, in March 2014, an independent expert panel tasked by MDA to assess the GMD interceptor fleet recommended that the program should consider implementing a plan to either hot-fire each ADT produced or hot-fire a sample of the ADTs produced in order to increase confidence in the ADT's performance and workmanship.
3. **Flight testing pace:** MDA is likely to continue to experience instability with the GMD flight test plan, reducing the level of knowledge obtained prior to completing fielding. In an October 2013 report submitted to Congress, MDA stated that it was limited in its

¹⁰GAO, *Best Practices: Capturing Design and Manufacturing Knowledge Early Improves Acquisition Outcomes*, GAO-02-701 (Washington, D.C.: Jul. 15, 2002).

¹¹GAO-15-345.

¹²GAO-12-486.

¹³GAO-12-486.

ability to properly plan, execute, and integrate the resultant test data for more than one GMD flight test per year. MDA also stated that, in order to meet fielding obligations of 44 interceptors by the end of 2017, all current interceptor production resources are devoted to manufacturing operational interceptors, which would effectively prevent MDA from increasing its flight testing pace. Nonetheless, with the concurrence of DOD stakeholders, MDA subsequently accelerated GMD's testing pace by planning to conduct three flight tests from fiscal years 2016 through 2017, according to MDA's most recent test plan. However, MDA's October 2013 assessment proved to be accurate, as all three tests have experienced delays:

- MDA conducted the first of three flight tests—a non-intercept, risk reduction test—in January 2016, a few months later than originally planned due to delays resulting from a recent target failure, the addition of new test objectives, and delays in delivering the flight test interceptor.¹⁴ Despite the delays, initial results from the flight test indicated the test was successfully executed.
- The second flight test—a demonstration intercept test for the CE-II Block I—has also experienced delays as a result of prior delays executing the January 2016 non-intercept test, CE-II Block I kill vehicle and booster development challenges, and test range availability.
- In providing technical comments for this report, MDA informed us that the third flight test—a salvo intercept test—has also been delayed to fiscal year 2018, just a few months prior to the first planned RKV flight test.

In March 2011, we recommended that MDA include sufficient schedule and resource margin in its test plan in order to ensure the test plan can absorb delays and remain executable.¹⁵ Although DOD partially concurred with our recommendation, DOD stated that maintaining cost/schedule margins is not cost effective and will instead continue to make updates to the test plan as needed. GMD's flight testing program has not been stable since 2005 and, without a change in its approach, MDA is almost certain to continue to pursue test plans that are unexecutable. Thus, we continue to believe that DOD should fully implement our March 2011 recommendation.

DOD's Reports Identified Several Potential Benefits to MDA's Redesigned Kill Vehicle (RKV) Acquisition Approach but Some Challenges May Exist

DOD's reports included a description of the RKV's acquisition approach that highlighted milestones, goals, and potential advantages. For example, MDA plans to conduct a non-intercept RKV flight test in fiscal year 2018 to establish the basis for ordering long lead items for producing eight initial RKVs. MDA plans to then conduct an RKV intercept flight test in fiscal year 2019 to establish the basis for ordering long lead items for producing an additional 37 RKVs. MDA also plans to conduct its second RKV intercept test in fiscal year 2020, which should allow MDA to begin delivering RKVs and emplacing them in the fielded interceptor fleet.

¹⁴MDA's new intermediate range target failed during a June 2015 flight test intended to demonstrate the BMDS's improved capability to defend regional allies and U.S. forces deployed to Europe. Consequently, successive tests reliant on this target, including the non-intercept GMD flight test that occurred in January 2016, were delayed.

¹⁵GAO, *Missile Defense: Actions Needed to Improve Transparency and Accountability*, GAO-11-372 (Washington, D.C.: Mar. 24, 2011).

In March 2006, we recommended that MDA implement a knowledge-based acquisition strategy that ensures that a high level of knowledge is obtained at key junctures in development— junctures we refer to as knowledge points.¹⁶ Aligning the RKV's production decisions with flight testing represents a major departure from the CE-II Block I's high risk approach and is a positive indication of MDA's intent to improve its acquisition outcomes. Once MDA establishes baselines for the RKV program, we will assess MDA's implementation of aligning production decisions with knowledge points that are informed by design stability and flight testing.

DOD's August 2015 report stated that the RKV's design will use a modular open architecture concept that will allow for making future upgrades easier and broaden the vendor and supply base. This approach may yield several benefits for the RKV development and future production effort. In the past, DOD has acquired proprietary systems that limit opportunities for competition and cannot readily be upgraded because the government is locked into the original suppliers. Conversely, an open system, such as a personal computer, allows system components to be added, removed, modified, replaced, or sustained by consumers or different manufacturers in addition to the manufacturer that developed the system. We have previously reported on the advantages of incorporating open system concepts into DOD acquisition programs, stating that designing weapons as open systems offers significant repair, upgrade, and competition benefits that could translate to millions of dollars in savings as the weapons age.¹⁷ Some of the fundamental elements of an open system include: (1) designing a system with modular components—components that isolate their functionality so that they can be changed without significantly impacting the remainder of the system; (2) developing and using open, publicly-available standards for the key interfaces between components that specify the physical, power, data, and/or other connections between components; and (3) government ownership of design drawings, specifications, and standards necessary for enabling competition for the modification and sustainment of a weapon system. DOD's most recent "Better Buying Power" initiative also emphasized incentivizing innovation in industry and government, in part, by using a modular open systems architecture to improve competition.¹⁸

DOD's reports highlight many of the potential advantages of its RKV acquisition approach. However, DOD's reports did not assess the potential disadvantages or challenges MDA may encounter with some aspects of its RKV acquisition approach. For example, there may be challenges with the RKV's contract strategy, industry collaboration efforts, and schedule:

- **Contract strategy.** MDA may be unable to meet all of its RKV commitments with its current contract strategy. According to program documents, MDA opted to use the DSC rather than conducting a full and open competition for the RKV development, in part, because it will potentially allow RKV delivery to begin sooner than if it had waited to

¹⁶GAO, *Defense Acquisitions: Missile Defense Agency Fields Initial Capability but Falls Short of Original Goals*, GAO-06-327 (Washington, D.C.: Mar. 15, 2006).

¹⁷See GAO, *Defense Acquisitions: DOD Efforts to Adopt Open Systems for Its Unmanned Aircraft Systems Have Progressed Slowly*, GAO-13-651 (Washington, D.C.: July 31, 2013); *Defense Contracting: Early Attention in the Acquisition Process Needed to Enhance Competition*, GAO-14-395 (Washington, D.C.: May 5, 2014); and *Defense Acquisitions: Review of Private Industry and Department of Defense Open Systems Experiences*, GAO-14-617R (Washington, D.C.: Jun. 26, 2014).

¹⁸DOD's Better Buying Power initiative outlines a series of actions, guidance, and directives to achieve greater efficiencies, in part, through the promotion of competition and the use of open system concepts. See Office of the Under Secretary of Defense, Acquisition, Technology and Logistics Memorandum: "Implementation Directive for Better Buying Power 3.0—Achieving Dominant Capabilities through Technical Excellence and Innovation" (Apr. 9, 2015).

complete a contract for the RKV prior to starting development. MDA has invested considerable resources on initial development activities in support of the RKV under the DSC and has made major commitments to industry, the warfighter, DOD, and congressional decision makers to design, test, and deliver RKV interceptors within specific timeframes and cost parameters. However, MDA has not negotiated the modification to the DSC with Boeing and, as such, the exact terms are unknown. For example, MDA plans to modify language in the DSC to allow for greater government ownership of technical data rights, but the details of this have not been negotiated or finalized. We previously identified examples where DOD has attempted to obtain needed technical data rights but were unable to because either the contractor declined to provide the data or acquiring the rights would be too expensive.¹⁹

- **Industry collaboration:** MDA may experience challenges fostering an open environment that facilitates collaboration among industry partners for the RKV. For example, DOD is attempting to implement an open system concept and strategy for its portfolio of unmanned aircraft systems. As part of this strategy, DOD has stressed that industry will have to be cognizant of potential organizational conflicts of interests when serving as an integrator and will need to weigh the pros and cons of competing for an integrator role vice a supplier role. In addition, shifting to an open architecture system will require industry to migrate to a model that supports open business and technical practices for system development and support. MDA may experience challenges managing the inter-relationships and fostering an environment that is collaborative amongst contractors who may later compete for the RKV full rate production contract if sufficient safeguards and protocols are not put in place. We plan to further assess MDA's management efforts in this area as part of our ongoing review of missile defense programs and will report our final results no later than March 15, 2017.
- **Schedule:** MDA has developed an aggressive schedule to begin fielding the RKV by 2020. Although MDA states that it does not plan to develop new technologies for the RKV, it intends to utilize some less mature technologies that have only been validated in a laboratory or simulated environment. As such, MDA may find it necessary to modify the form, fit, and function of some components for use in the RKV. For example, MDA plans to use commercially-available components in the RKV that may not have been designed to operate in the harsh environment in which the kill vehicle may operate. MDA plans to apply design techniques to harden or shield components so that they can survive in the harsh environment but this may require additional time to verify the design changes. However, with the RKV's first flight test occurring in fiscal year 2018, it is unclear whether MDA has allowed enough time for modifying and maturing technologies. MDA previously experienced such challenges developing a system of satellites that could track enemy missiles while operating in the harsh environment of space. MDA selected mature technologies for the satellite's design but some components required additional radiation protection and put the program at risk for schedule delays. We found in July 2013 that MDA later canceled the program, in part, because of such technical risks.²⁰ Although the schedule is aggressive, MDA has developed a schedule that

¹⁹GAO, *Weapons Acquisition: DOD Should Strengthen Policies for Assessing Technical Data Needs to Support Weapon Systems*, GAO-06-839 (Washington, D.C.: Jul. 14, 2006).

²⁰GAO, *Missile Defense: Precision Tracking Space System Evaluation of Alternatives*, GAO-13-747R (Washington, D.C.: July 25, 2013).

indicates both objective and threshold dates for milestones. This should provide MDA some margin in its schedule to mitigate the accumulation of schedule-driven risks.

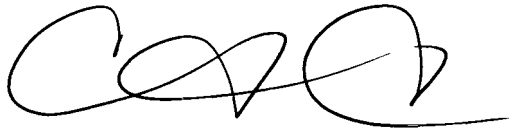
Agency Comments

We provided a draft of this report to DOD for review and comment. DOD provided technical comments, which were incorporated as appropriate.

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We are sending copies of this report to the appropriate congressional committees and to the Secretary of Defense. In addition, the report is available at no charge on the GAO website at <http://www.gao.gov>.

If you or your staff have any questions about this report, please contact me at (202) 512-4841 or chaplainc@gao.gov. Contact points for our Offices of Congressional Relations and Public Affairs may be found on the last page of this report. GAO staff who made key contributions to this report are: LaTonya Miller, Assistant Director; Stephanie Gustafson; Kristine Hassinger; Kevin O'Neill; Steven Stern; Brian Tittle; and Hai V. Tran.

A handwritten signature in black ink, appearing to read 'Cristina Chaplain', with a stylized, cursive script.

Cristina Chaplain
Director, Acquisition and Sourcing Management

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